# 國立中山大學106學年度碩士暨碩士專班招生考試試題

科目名稱：作業系統與資料結構【資工系碩士班甲組】　　題號：434003

※本科目依簡章規定「不可以」使用計算機(問答申論題)　　

**INSTRUCTIONS: If any question is unclear or you believe some assumptions need to be made, state your assumptions clearly at the beginning of your answer.**

1. (10%) What would be the output of the following C program that uses the Pthreads API? (*Note that the line numbers are for reference only.*)

```
 1 #include <stdio.h>
 2 #include <stdlib.h>
 3 #include <unistd.h>
 4 #include <pthread.h>
 5 #include <sys/types.h>
 6 #include <sys/wait.h>
 7
 8 static void *runner(void *param)
 9 {
10     (* (int*) param)--;
11     pthread_exit(0);
12 }
13
14 int main(int argc, char **argv)
15 {
16     int value = 101;
17     pid_t pid = fork();
18     if (pid > 0) {
19         int status;
20         waitpid(-1, &status, 0);
21         printf("A = %d\n", --value);
22     }
23     else if (pid == 0) {
24         pid_t pid = fork();
25         if (pid > 0) {
26             int status;
27             waitpid(-1, &status, 0);
28             printf("B = %d\n", value--);
29         }
30         else if (pid == 0) {
31             pid_t pid = fork();
32             pthread_t tid;
33             pthread_create(&tid, NULL, runner, &value);
34             pthread_join(tid, NULL);
35             if (pid > 0) {
36                 int status;
37                 waitpid(-1, &status, 0);
38                 printf("C = %d\n", ++value);
39             }
40             else {
41                 printf("D = %d\n", value++);
42             }
43         }
44         else {
45             return 1;
46         }
47     }
48     else {
49         return 1;
50     }
51     return 0;
52 }
```

背面有題

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2. (10%; 5% each) Assume a page reference string for a process with $m$ frames (initially all empty). The page reference string has length $n$ with $p$ distinct page numbers occurring in it. For any page-replacement algorithms,

   (a) What is an upper bound on the number of page faults?

   (b) What is a lower bound on the number of page faults?

3. (10%) A computer whose processes have 2048 pages in their address spaces keeps its page tables in memory. The overhead required for reading a word from the page table is 600 nsec. To reduce this overhead, the computer has a TLB, which holds 64 (page, frame) pairs and can do a lookup in 100 nsec. What hit rate is needed to reduce the mean overhead to 200 nsec or less?

4. (10%; 5% each) Given a UNIX $i$-node with ten direct blocks and three levels of indirect blocks (i.e., a single, a double, and a triple) and assuming that the sizes of a pointer and a block are, respectively, 8 bytes and 8 Kbytes, answer the following questions.

   (a) What would be the size of the smallest file allowed in bytes?

   (b) What would be the size of the largest file allowed in bytes?

5. (10%; 5% each) A disk has 24000 cylinders, each with 16 tracks of 512 blocks. A seek takes 1 ms per cylinder moved. If no attempt is made to put the blocks of a file close to each other, two blocks that are logically consecutive (i.e., follow one another in the file) will require an average seek, which takes 6 ms. If, however, the operating system makes an attempt to cluster related blocks, the mean interblock distance can be reduced to 2 cylinders and the seek time reduced to 200 $\mu$s. Assuming that the rotational latency is 3 ms and the transfer time is 10 $\mu$s per block, answer the following questions.

   (a) How long does it take to read a 300 block randomly placed file?

   (b) How long does it take to read a 300 block clustered file?

6. (10%) *Declare* in a single statement in C a pointer "p" to the array "`int a[256];`" so that `p[1]` is an alias of `a[0]`, `p[2]` is an alias of `a[1]`, and so on, all the way up so that `p[256]` is an alias of `a[255]`.

7. (10%) The Ackermann function $A(m, n)$ is defined recursively for non-negative integers $m$ and $n$ as follows:

$$A(m,n) = \begin{cases} n+1 & \text{if } m = 0, \\ A(m-1,1) & \text{if } m > 0 \text{ and } n = 0, \\ A(m-1, A(m, n-1)) & \text{if } m > 0 \text{ and } n > 0. \end{cases}$$

   Its value grows very quickly, even for small values of $m$ and $n$. For instance, $A(1,1) = 65533$. What would be the value of $A(2,3)$?

8. (10%) Assuming $n = 2^m$, write out the closed form solution for the recurrence relation

$$T(n) = \begin{cases} 1 & \text{for } n = 2, \\ 2T(n/2) + 2 & \text{for } n > 2. \end{cases}$$

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9. (10%) Analyze the behavior of QUICKSORT in the case where a schizophrenic adversary picks the best possible splitter (partitioning element) instead of the worst, every other time (i.e., he alternates between best and worst). What running time is induced by this "adversary?"

10. (10%) Transform the following expression to prefix and postfix.

$$(A+B)*(C+D-E)*F$$